Retention of the Inoculativity of the Papaya Mosaic Virus by the Green Peach Aphid[1]

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The maximum retention time of the inoculativity of various nonpersistent viruses by feeding aphids has been reported to be as short as a few minutes to up to 10 hours (Sylvester, 1954). With regard to nonpersistent papaya viruses, the inoculativity of the papaya ringspot virus of Hawaii has been reported to be retained by *Myzus persicae* (Sulzer) for less than 5 min (Jensen, 1949). The inoculativity of the virus of the papaya mosaic of Bombay, India was reported to be retained by feeding *M. persicae* for 1 to 2 hours, but less than 1 hour by *Aphis gossypii* Glover (Capoor and Varma, 1958). Inoculativity of the papaya leaf reduction virus was retained by feeding *M. persicae* for 4 but not 5 hours (Singh, 1971).

The retention of inoculativity by aphids of the virus of the papaya mosaic of Hawaii has not been ascertained although the virus is known to be of the nonpersistent type. The papaya mosaic has become a limiting factor in the growing of papaya in the State of Hawaii and specific knowledge of the retention time would be important for the control program.

The retention time of the inoculativity of the papaya mosaic virus by the green peach aphid, *M. persicae*, under post-virus-acquisition fasting and feeding conditions and under different temperatures, is reported herein.

METHODS AND MATERIALS

The vectors used in the experiments were late instar apterae of *M. persicae*. Nonviruliferous colonies of this aphid have been maintained in cages on mustard cabbage, *Brassica juncea* (L.) in our greenhouse for many years. The test plants were seedlings of cucumber, *Cucumis sativus* L. var. Colorado Long. The virus source was papaya, *Carica papaya* L. var. Solo, infected with papaya mosaic.

The aphids were fasted for at least 1/2 hour in glass vials prior to use in the tests. Fasted aphids were placed in mass on a virus source plant and allowed an access time of 2 to 5 minutes to acquire the virus. They were then, depending on the experiment, either fasted in glass vials, placed on mustard cabbage and allowed to feed, or placed in glass vials and kept at room temperature (about 25°C) or in a refrigerator (5°C). The aphids were kept under these conditions for various periods of time after which they were placed on test plants, one aphid per plant, to determine how long they had retained the inoculativity of the virus.

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TABLE 1. *Transmission of papaya mosaic virus by the green peach aphid after postacquisition fasting.*

Trial	Postacquisition period in minutes																		
	0	10	20	30	60	0	60	90	120	0	120	180	240	0	300	360	0	420	480
A	20*	9	7	7	7	4	2	0	0	10	0	0	0	19	1	5	12	1	0
B	15	6	4	3	3	6	2	4	2	15	0	0	0				15	0	0
C	16	4	6	5	5	3	0	0	0	16	2	0	3				10	3	0

*number of plants infected out of 50 tested

Results and Discussion

Data on retention of inoculativity by the green peach aphid under various conditions of this experiment are presented in Tables 1, 2, and 3. The rate of transmission by aphids fasted in vials declined rapidly within 10 minutes after the virus acquisition access period. Transmission continued at a low rate up to 7 hours and no transmission occurred at 8 hours. With aphids that were placed on mustard cabbage after the virus acquisition access period, there was a sharper decline in the transmission rate and the longest retention of inoculativity was 30 minutes and no transmission occurred at 60 minutes. In this test most of the aphids, when taken from the virus source plant and placed on mustard cabbage, assumed a feeding position immediately and remained in that position for most of the test period. Only aphids in the feeding position at the end of the test period were transferred to the test plants to ascertain inoculativity. The results indicate definitely that the inoculativity is lost faster and retained for a shorter period by aphids which are feeding during the post-virus-acquisition period than by those which are fasting. This is the case with many nonpersistent virus relationships (Sylvester, 1954). Thus, in the field, an aphid that has fed on a diseased plant is less likely to infect a healthy papaya plant if it feeds enroute on any other plant, than is an aphid which goes directly from a diseased to a healthy plant, even if it takes a longer time to get there.

There was no difference in the retention of inoculativity of papaya mosaic virus between aphids held at 25°C and 5°C. The aphids were held in vials without food and tested at 2 and 4 hours after the virus acquisition access period. With some nonpersistent viruses the rate of decline of inoculativity is less at lower temperatures and therefore the retention of inoculativity is longer at lower than at the higher temperatures (Sylvester, 1954). Perhaps with the papaya mosaic virus-green peach aphid relationship, if the aphids were subjected to lower temperatures than the one used in this experiment, an expression of temperature effect on retention would have occurred.

Some commercial papaya growing areas in the State are free of the papaya mosaic. To protect these areas, movement of host material of the virus — cucurbits and *Carica* spp. — into these areas is banned. In conjunction, the surrounding areas are surveyed and all papaya mosaic diseased plants found are rogued. A disease-free belt surrounding the papaya orchards is established and frequent surveys are conducted to make sure that this belt remains disease free. The extent of the belt would depend in part on the duration of the retention of the inoculativity of the virus by the aphid vectors and their rate of dispersal. So far, a belt about a mile wide has been effective in the papaya growing area of Puna, Hawaii. However, this distance may not be adequate for all locations. Geographic, floristic and wind conditions are some other factors which may affect the distance that the virus can be disseminated within the retention time of the inoculativity.

TABLE 2. *Transmission of papaya mosaic virus by the green peach aphid after postacquisition feeding on mustard cabbage.*

Trial	Postacquisition period in minutes				
	0	10	20	30	60
A	8*	0	0	0	0
B	20	0	0	0	0
C	17	2	1	1	0
D	18	3	1	0	0

*number of plants infected out of 50 tested

TABLE 3. *Transmission of papaya mosaic virus by the green peach aphid after postacquisition fasting at 25° C and 5° C.*

Trial	Temp.	Postacquisition period in minutes		
	°C	0	120	240
A	5		3*	1
	25	21	0	2
B	5		0	1
	25	9	0	1
C	5		2	0
	25	9	1	1

*number of plants infected out of 50 tested.

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